

## Accelerator Systems Division Highlights for the Two-Weeks Ending April 5, 2002

### ASD/LBNL: Front End Systems

#### ASD/LANL: Warm Linac

We operated the first production 402.5-MHz Marconi klystron with the first Titan-Beta transmitter up to 750-kW operating power with 1.3-ms pulses at 60 Hz (see Fig. 1). In the coming weeks this system will be boosted to 2 MW and used to perform the site acceptance test on this klystron. (WBS 1.4.1.1)



Fig. 1: Marconi 402.5-MHz klystron and Titan-Beta transmitter under test.

We used the 805-MHz klystron to high-power test four 550-KW circulators and two 550-kW loads. (WBS 1.4.1.1)

We began a two-week acceptance test of the first production 805-MHz, 5-MW transmitter at Titan-Beta. (WBS 1.4.1.1)

LANL staff will go to Marconi next week for acceptance tests of the second 402.5-MHz klystron. (WBS 1.4.1.1)

The prototype HVCM provided the high-voltage drive (up to 99 kV) for the Marconi klystron tests. It was also used for the other high power RF component tests noted above. (WBS 1.4.1.2)

The first Dynapower production transformer was installed outside of MPF-18, the high-power RF lab at LANL (see Fig. 2). (WBS 1.4.1.2)

We completed the acceptance tests of the first production HVCM control rack at ZTEC. It will be delivered to LANL next week. (WBS 1.4.1.2)

The last two DTL tank sections for Tank 2 were accepted on Tuesday and shipped to GSI in Germany on Wednesday of this week. Three tank sections are already at GSI, and these last two are expected to arrive next week. DTL staff will be traveling to GSI this weekend to begin copper plating the tank sections for Tanks 1 and 2. (WBS 1.4.2.2)

The last BPM drift tube was delivered on April 1. It is currently being tested by the LANL diagnostics team (see below) and will be ready for installation on April 9. (WBS 1.4.2.3)



Fig. 2: Dynapower production transformer installed at LANL.

We completed testing and mapping the two vertical-EMD drift tubes for Tank 3. Both drift tubes look very good with no problems to report. These two drift tubes are now at Coronado for final machining. (WBS 1.4.2.3)

One of the horizontal EMD drift tube did not pass the vacuum test. The vacuum leak was isolated to the joint required in the clamshell design. This drift tube is now at ISIS for repair, and the expected delivery date for all four EMDs is April 10. If the leaking EMD is not repaired by then, Coronado will fabricate and deliver an aluminum mock-up to allow us to proceed with tuning. (WBS 1.4.2.3)

We will begin final alignment of DTL Tank 3 on April 11 and plan to start tuning by April 15. (WBS 1.4.2.7)

CCL staff traveled to Accel Instruments in Germany to review progress on the first intermediate milestone, which is Accel having a signed contract with its subcontractor for machining the CCL cells. After meeting with Accel the LANL staff traveled to the subcontractor's facility to observe progress on test samples. Based on what we observed, we believe Accel will award their contract within the next few weeks. (WBS 1.4.4.2)

We received the report from the final diagnostics design reviews held in March. No showstoppers were identified, and the committee recommended that we proceed to final fabrication. (WBS 1.4.5.2)

We received DTL BPM #3-2 this week and have preliminary maps and RF tests for both #3-8 and #3-2. Both BPMs exhibit symptoms of cable damage, likely caused during repairs to the drift-tube stems. The electrodes on these BPMs are also deformed. The mapping data shows that these BPMs can be used to measure beam position, but their performance is marginal and may possibly change with time. We plan to proceed with installation and decide later if the budget will support replacing them. (WBS 1.4.5.2)

Fabrication continues on the eight remaining DTL BPMs (see Fig. 3). (WBS 1.4.5.2)



Fig. 3: DTL BPMs showing all the electrodes and one example of a housing

Improvements continue to the LabView code for the BPMs in preparation for beam tests at LBL next week. Last week LANL staff traveled to LBL to troubleshoot some EPICS/LabView communications problems with the BPM and WS systems. The problems were solved, and we are now ready for tests with beam. (WBS 1.4.5.2)

Code work continues on adapting the DTL tuning program to run on a modern operating system in preparation for Tank-3 tuning. Code work also continues on understanding the behavior of deflected beam from the chopper through the MEBT. (WBS 1.4.5.3)

Los Alamos and Oak Ridge SNS project management met this week to discuss handoff of project-related activities such as procurement, property and project controls. Los Alamos also presented their current project performance and discussed with Oak Ridge how to roll their contingency analysis into the ORNL's Management Estimate. We also had a productive discussion of procurement performance metrics and how to improve them. The meeting overall was quite productive with general agreement on a path forward on the handoff of procurement, property and project controls activities. Los Alamos project performance remains quite good, and projected contingency draws appear consistent with project reserves. (WBS 1.4.6)

Two PCRs were approved by ASD and were implemented this week. Bundled PCR-LI-02-018 returned \$265 K to contingency, and PCR LI-02-019 returned \$400 K of HVCM procurement savings to contingency. (WBS 1.4.6.1)

LANL transferred \$600 K to ASD this week for installation labor on LLRF and DTL systems. (WBS 1.4.6.1)

#### **ASD/JLAB: Cold Linac**

Prototype cryomodule assembly continues. Assembly of the completed space frame, with cold mass, thermal and magnetic shields, multi-layer insulation and cabling is complete. Minor fit-up adjustments of the piping in the return end can are well advanced.

The 1 MW RF test stand is in operation in support of Fundamental Power Coupler (FPC) processing. Several minor interface problems between the FPC cart and the RF system have been identified and are being corrected. Installation of components of the Personnel Safety System (PSS) for coupler processing is complete.

#### **ASD/BNL: Ring**

R. Connolly traveled to SLAC this week to attend a review of the laser monitor.

Connolly, Cameron, Peng, and Dawson will travel to Berkeley this weekend to help s/u MEBT diagnostics and diagnostic controls.

Alex Zaltsman was at SNS/OR earlier this week to review Ring RF issues related to Installation, Spare Parts and Equipment Protection.

HEBT "Y" box vacuum chambers; 4 received from vendor. They are being set-up for laser tracking inspection

1st article turbo pump station is being shipped to BNL this week.

Fabrication drawings for the welding fixture for the 21cm quad vacuum chamber are complete.

Received acceptance of magnetic measurements from ASD on the HEBT 12Q45 quadrupole. This info has been passed along to Danfysik.

Automation of the dipole measuring station was finished earlier this week (transverse plane). Efforts are underway to resume dipole testing.

Sextupole (21CS26) (#2) testing was finished this week. Data analysis and magnet acceptance are underway. Prelim results look good.

21Q40 quad 1<sup>st</sup> article (#2) – magnet is on the test stand and being surveyed for magnetic measurements which will begin early next week.

Ms X. Geng joined the SNS/BNL Controls Group this week. Two addition people are expected by May 1<sup>st</sup>.

Two low field power supplies arrived form Danfysik earlier this week for testing at BNL prior to final acceptance testing at the Danfysik factory. Arrangements are being made for ASD personnel to assist with the testing at BNL.

The laser, recently received from LANL, is set up and operating in the AGS linac. We are scheduled to have an access on 4/8 for final adjustments prior to dedicated data taking around mid April.

Diagnostic cabling info submitted to ORNL, as requested.

IPM - work continues on prototype test of luminescence monitor in the AGS Ring.

Converged on a singular set of Global Survey coordinates between principal parties at ASD and BNL (Physics, Survey, Mechanical).

Mauro Pivi of Berkeley was at BNL last week and spoke to members of the Accelerator Physics Group on Electron Clouds.

APPs are being updated for FY02 and FY03.

Received a PCR from ASD on scope transfer related to the linac and extraction beam dump vacuum windows (passive). Determination of BNL efforts to date is in progress to support this transfer.

Vendor Status:

BINP: Coil winding is underway. Winding is slow but the initial results (photos) look very good. Vacuum impregnation is scheduled for next week. Core machining is progressing without major issues.

Danfysik: Another eight sextupoles 27CDM30 shipped last week (n = 7+ 8). They were given the go-ahead to start the production run on the 12Q45 quadrupoles based on ASD's acceptance approval.

NE Techni-Coil: They will ship the first production (2<sup>nd</sup> article) octupole later this week. Then, we can expect one per week starting by May 1<sup>st</sup>. 1<sup>st</sup> Chicane dipole is in progress. Expect shipment to BNL by mid May

Tesla: HEBT Dipole #2 sent to SNS/OR in March. Was at Charlotte Docks 10 days ago. Awaiting our approval on the 21Q40 before starting their production run.

## Controls

Bids for Conventional Facilities Controls sensors were received and analyzed. Costs are below expected estimates and suppliers are very well qualified. A report will be submitted to procurement next week.
















At Berkeley, 11 MEBT quadrupole and 12 steerer power supplies were brought online under EPICS. The MEBT vacuum system is complete and online, as is the cooling water and pressure (but no temperatures). The controls team supported the first beam through the MEBT. All new Front End control screens can be observed at ORNL on the lab console.

In preparation for the anticipated delivery of Phase 0 PPS racks to the RATS building PLC software has been purchased, a PLC workstation computer has been made available and PLC configurations and tag names have been generated for the A, B, and C PLCs. Drawings for additional miscellaneous PPS Phase 0 hardware have been issued for comment.

The second prototype radiation detector (Chipmunk) was put through a temperature cycling test at a commercial facility. The temperature cycling was similar to the test conducted at Fermilab (+50 to 30 deg. C). The background count rate was monitored during the temperature cycling. The background pulse rate fluctuated during the test more than the tolerance allowed by the Fermi test procedure. We have sent the data to Fermi to help us understand the problem.

An environmental test chamber has been ordered for use at RATS. Additional temperature cycling testing and radiation calibrations are planned for both units prior to releasing the production procurement contract.

A final design review for the utility module was held at LANL in February. This module is used by each IOC to decode timing events and time stamps and to monitor the state of health of the IOC. Three prototype boards are complete and one will be shipped shortly to BNL for testing. The module is under test in Oak Ridge. An EPICS test screen is shown below.

Utility Module Status for timingMaster			
FIFO High Empty		Event Link FIFO Status	ID: .S.N.S.V.1.0.8.S.....A.....0.0.0.2.
FIFO High Full			Up: 1.4266 Hours
FIFO Low Empty			Mar 26, 2002 11:43:45.706124
FIFO Low Full			Timestamp Fault 
FIFO Low Full ERR			Remote Reset 0xca9655
FIFO High Full ERR		Communications Status	RTDL Xmit Errors 0
RTDL Fault			EV Frame Errors 90
EVLINK Fault			EV Parity Errors 82
Over Temp		Environmental Status	Temperature 28.50 degC
+5V Fault			+5 Volts 4.96 V
-12V Fault			+3.3 Volts 3.30 V
+12V Fault			+12 Volts 12.05 V
Fan Fault			-12 Volts -11.92 V
+3.3V Fault			+5 Volts Ripple 0.00 V
Chan A Interrupt		External Signal Status	+3.3 Volts Ripple 0.00 V
Chan B Interrupt			
Chan A First			
			<div>EXIT</div>

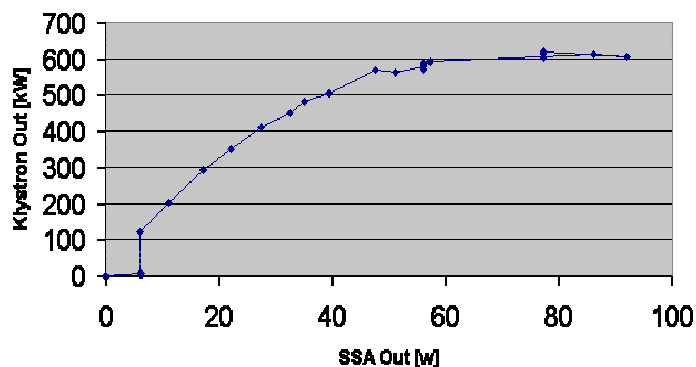
The first klystron is running at LANL, and EPICS archiving allowed the generation of the power transfer curve below. ("SSA out" is the Solid State Amplifier Output, which is equivalent to the klystron input, which drives the klystron. The gain is then:

$$\text{Klystron Gain [dB]} = 10 \log_{10} (\text{Klystron Output} / \text{Klystron Input}).$$

The chart indicates a gain of 40 – 45 dB.

## Power Transfer Curve

1st SNS Klystron, April 2, 2002



At LANL, tests were also completed on the effect of RF power on category-5 cable used for network communication. The implications of these results on network cable installation at ORNL are under discussion.

Network, event link, real-time data link, serial interfaces, and machine protection wiring is completed for the DTL. Rack layouts for the DTL are being finalized.

The XAL library was modified at LANL to support shared channel behavior. This supports the implementation of a change in one accelerator object affecting another. A new development area was set up for the ORNL physics group. Physics applications can now be displayed in our mock-up control room.

A "freeware" Linux-based intrusion detection system (IDS) was deployed at ORNL. The commercially available equivalent costs "tens of \$K"

At BNL, meetings were held to review the interfaces between various beam diagnostics devices and the control system. BNL also received two test power supplies that are being tested using the PSC/PSI and labview software.

### Installation

Friday April 5 Tom Mann and Randy Musick led the installation meeting with a discussion of the ASD sub-project schedule, which is a rollup of the ASD detailed installation and other ASD schedules.

### Accelerator Physics

A proposal was made for an additional quad between in the SCL and HEBT transition (ASD post-it note number 49). This quad reduces the beam size, and prevents the transition region from being a limiting aperture.

Preliminary studies into the failure of the first SCL cavity indicate that this failure mode is not a show stopper. Even with no rematching, the longitudinal emittance grows only 25%, and the transverse grows 7%. There is ~ 10 MeV energy loss, with the missing cavity, that would have to be made up in the remaining cavities (or else re-tune the ring). Operation with a failed first cavity should be possible, and reduces the importance of having the precipitators. See ASD post-it note 50.

A new parallel implementation of the ORBIT code was produced using the MPI message-passing library. The longitudinal and 2-D transverse space charge methods are parallelized. The 3-D space charge and transverse impedance models will be made parallel next.

A note (ASD post-it note number 46) and transmittal describing the shape of the ring collimator aperture shapes was written. Three out of four collimators now have simpler round apertures.

## **Operations**

Integrating the XFD ICOP with the ASD CPP for DOE.

Integrating XFD Commissioning into the project commissioning timeline

Updated and evaluated ASD Spares list

Processing and conditioning

- Worked on DTL Tank 3 safety and processing systems

- Worked on PPS safety for Front End processing and commissioning

Operations Procedures

- Integrated ORNL SBMS Documents into ASD OPM

- Documenting operating procedures for Front End System

- Writing PPS search procedures

Review Documentation

- Proceeding with obtaining ASD Technical Review documentation and storing it in IMAN as required for the Accelerator Readiness Review Process

Worked with Controls on Signal Naming Convention

Worked with the CDD on the SNS Document folder structure

MIS: Barcoding entry form.

## **Ion Source Group**

The capacitive matching network designed by John Staples has been received from LBNL and installed on the LBNL startup ion source. Yoon Kang helped to tune it to the 2 MHz and the 13 MHz frequency using his network analyzer.

A substantial leak has been identified in a weld of the LEBT vacuum vessel. It was successfully repaired by rewelding.

Requests for quotes for the emittance scanners have been released.

Two meetings with operations- and safety-staff discussed different avenues for starting up the LBNL startup ion source in the RATS building following the appropriate DOE and ORNL guidelines. A major focus is to minimize negative impact on other efforts.

The damaged 2 MHz amplifiers has been received by QEI. The repair is estimated to take 3 weeks and cost 9k\$ for parts and 7 k\$ for labor. Repairs have been authorized

## **RF Group**

## **Mechanical Group**

Following discussion with the partner labs it was been agreed to adopt an Ethernet communication protocol for the RGA's that has a number of advantages over a RS-485 communication link initially proposed. An amendment to the BOA has been requested to reflect this no cost change.

The flight tubes were chemically washed with final de-ionized water rinse in preparation for re-testing that has been delayed until early next week due to minor problems experienced with the calibration test set-up.

The first vacuum test rack was populated and wired and is now available for equipment testing.

The large ultrasonic cleaner and air drying oven were set-up and are now operational and available for cleaning and drying of vacuum component prior to use or storage.

Accelerator equipment received this week included a quantity of ion pumps and gate valves for the DTL/ CCL installation.

The first article RGA and spare a unit were received and preparation for first article testing will commence next week.

A portable leak detector incorporating dry pumps was received for evaluation, and is currently being used by the Ion Source Group for leak testing of the ion source.

### **Magnet Group**

This week, based on preliminary measurements, we gave Danfisik the approval to proceed with production of 12Q45 Quadrupoles.

We installed a Beam Tube in the first HEBT 8D533 Dipole, tested it for vacuum, and re-measured the gap in the magnet. All is well with the magnet assembly and it will be put back in the box and await installation into the beam tunnel.

We are also getting involved in the Ring Bus manufacture.

### **Cryogenics Group**

We have successfully moved and installed the first 80 foot sections of transfer line from RATS building into the CHL to the tunnel chases. We also have placed the second 80 ft sections of transfer line on rollers in the cold box room and are welding the coaxial pipes together. When this effort is completed we will insert the second 80 foot sections into the conduits. This effort also includes the warm gas piping from the CHL to the tunnel.

We are currently assembling the 3rd and 4th medium Bata supply transfer line modules. The tooling is complete for the return transfer line modules and is currently being installed. Production is estimated to start next week.

The additional pipes have been delivered. The Wachs machine to cut and prep the pipes is on order and should arrive next Thursday. WE will be setting the head and pipes on stands this week in preparation for the Wachs equipment.

### **Electrical Systems Group**

#### **Survey and Alignment Group**

The Survey & Alignment Group is in the third week of Phase II measurement campaign. Our goals are as follows:

1. To re-establish and re-measure the outside global monument system. As you may or not be aware, over the last three months, no less than five monuments have been damaged by construction. The net results are these five monuments must be remeasured and adjusted into existing data.
2. Transfer the exterior global survey network into the linac tunnels via three penetration points.
3. Measure all floor and wall monuments throughout linac and FE with laser tracker.
4. Measure linac/FE floor elevations.



In order to keep this campaign moving and to have the SNS Global Survey Network in place by June 1, we are presently working seven days a week. In the event of inclement weather where exterior work cannot continue, we have now moved a laser tracker to the site. If our night crew cannot work outside, they will switch operations to measurements inside the tunnel.

### **Beam Diagnostics Group**

#### **LANL Beam Diagnostics Progress Report:**

**BPM pickups:** We received DTL BPM #3-2 this week. We now have preliminary maps and rf tests for both #3-8 and #3-2. Both BPMs exhibit symptoms of cable damage, likely caused during repairs to the drift tube stems. The electrodes on these BPMs are also deformed. The mapping data shows that these BPMs can be used to measure beam position, but their performance is marginal and may possibly change with time. However, we plan to proceed with installation into DTL tank 3, and then decide later if the budget will support replacing them. Fabrication continues on the eight remaining DTL BPMs. The drawings for the modified CCL electrodes are ready for checking. Drawing modifications for the SCL BPMs will begin soon.

**BPM electronics:** Improvements continue to the LabView code in preparation for beam tests at LBL next week. Last week Matt Stettler traveled to LBL to troubleshoot some EPICS/LabView communications problems with the BPM and WS systems. The problems were solved and we are now ready for tests with beam.

**WS actuators:** The purchase order was placed for the next version 6-inch and 3-inch prototype actuators. We received quotes from Huntington for the various types of forks including collets. As requested by JLab, we will change the collet design to be more compatible with the vacuum requirements. Work continues at JLab to test and qualify the SCL WS actuator and beam box.

**WS electronics:** LabView code development continued in preparation for the FES tests at LBL next week.

**CMs:** The DTL CM transformers have been shipped back to Bergoz for cabling modifications.

**D-plate:** Final detailing work continues. We have successfully changed our design to use supporting struts from the LEDA project. Detailing work is in progress on emittance slits.

**Misc:** We received the report from the final design reviews held March 12-14. No showstoppers were identified, and the committee recommended that we proceed to final fabrication. Wynn Christensen, John Power, Chris Rose, and Matt Stettler will travel to LBL next week to support the FES tests.

#### **BNL Beam Diagnostics Progress Report:**

**General:** Group members' submitted cabling information to ORNL

**1.5.7.1 BPM:** Work continues on Ring and RTBT electronics conceptual design, investigating the possibility of switching the LO in the AFE to permit digitizing either 400MHz or base-band BPM signals from all PUEs.

**1.5.7.2 IPM:** Work continues on prototype test of luminescence monitor in the AGS Ring.

**1.5.7.3 BLM:** Both the new design and old design are now functional. A decision must now be made as to which design to use. A request to have a videoconference to discuss this subject has been made.

**1.5.7.4 BCM:** A representative will be sent to LBNL to assist with testing of the BCM electronics with Beam next week. The second revision to the artwork is complete. The artwork has been checked, and fabrication will start ASAP. An initial layout of the BCM mechanical drawings has been prepared. We are looking to LANL to do an analysis of the cavity resonance.

**1.5.7.5 Tune:** Simulations of spectral response of beam kicked continuously during 1000 turn accumulation are now running, and refinements to this modeling of the transfer function measurement of the ring tune footprint are progressing. These simulations are also being utilized in refinement of the beam-in-gap system design.

1.5.7.6b Laser Wire Scanner: 200MeV Linac access was gained, power was cycled on the controller and laser is again operating properly. Vacuum access is scheduled for 8 Apr to replace the oil/varnish on the optics, with dedicated beam time scheduled for approximately one week later.

Roger Connolly traveled to Berkeley to work on setup of the MEBT laser wire, then on down to SLAC for the laser wire workshop. Sheng Peng of the BNL Controls group is also at Berkeley working on the MEBT laser wire motion control and DAQ.

#### ORNL Beam Diagnostics Progress Report:

Craig finished the design of the SCL BPM electrode and wrote a technote on it. He has started to model and analyze the SCL beam box for modes and E/M wire heating. The diagnostic advisory committee raised this question. Wim wrote a Wire Scanner analysis application program incorporating the recent request by John Staples to view the moments of the transverse profile via EPICS's PVs. Dave, Craig and Wim are working on remote reboot of the smart devices using the APC power strip. NPS Master-Switch VM installed and successfully tested. Dave also prepared a PC for LBNL's laser wire test. He shipped the PC to LBNL. At Berkeley, Tom and Saeed helped prepare for next week's diagnostics beam run. Roger and company installed the Laser wire on the MEBT. Initial beam tests of the MEBT laser wire and the beam current transformer were both successful. Wire scanners and position monitors will be tested next week after the experts arrive. Tom and Saeed also attended the Laser wire mini-workshop at SLAC. Warren Grice presented optical transport design. Sasha and Bob Shafer and others discussed the electron detection schemes. The SNS group is grateful to our SLAC collaborators. They have injected many valuable insights into the discussion. We are working with the EE group on cable requirements. We have collected cable information from the partner labs and compiled it for Paul and Theresa.